Regulatory Requirements for NMP Permit Terms

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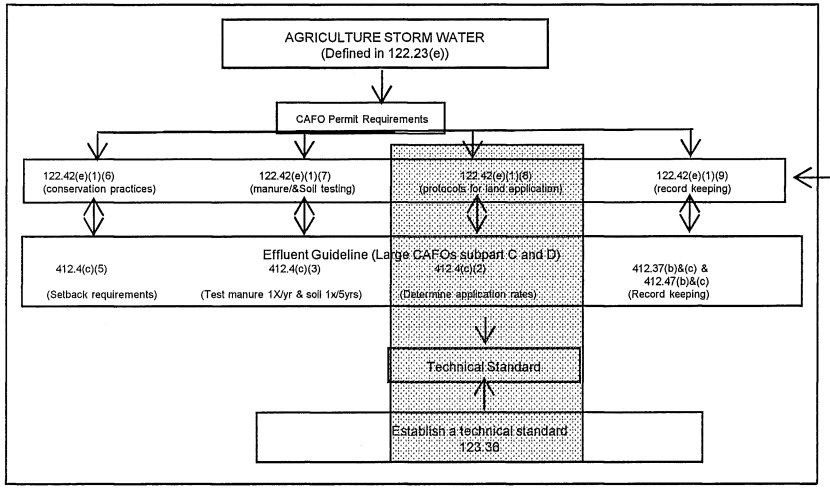
Session Topics

- Terms for both Linear and Narrative Rate Approaches
  - What is the regulatory requirement
  - How the term may be informed by the technical standards
    - To help in the review of a NMP



CAFO Permit Requirements for an NMP
122.42(e)(1)

Site Specific Terms of the NMP
122.42(e)(5)

122.42(e)(1)(8) & 412.4(c)(2)

Field Specific Rates

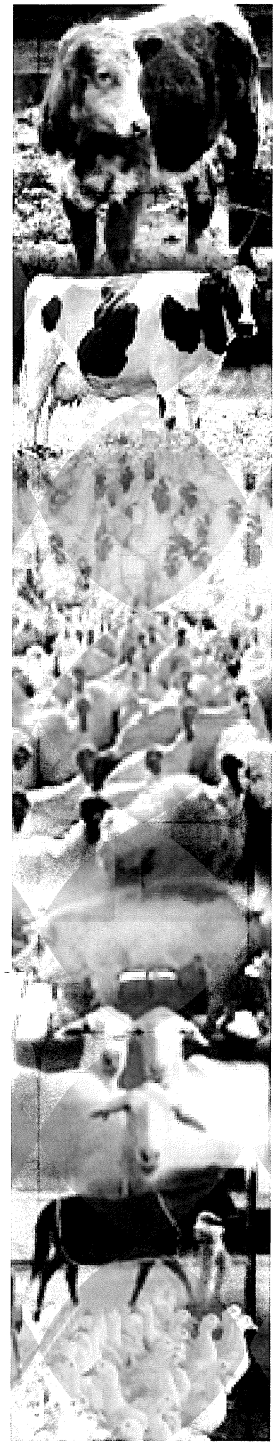
Linear Rate	Narrative Rate
Fields	**Fields**
Timing limitations	**Timing limitations**
Field risk assessment	Field risk assessment
Crops	Crops and Alternative s
Yield Goals	Yield Goals
Credits for PAN	Methodology: •Soil test results •N and P in manure •Multi-year P •Other additions of PAN •Form & source of manure •Timing and method •Volatilization and mineralization
Multi-year P	
Other additions of PAN	
Method and timing	
Form & source of manure	
Max. lbs of N and P from manure	Max. N and P from all sources

Technical Standard

1. A field specific assessment
2. Standards must address, for the application of nutrients;
   - Amount
   - Form
   - Source
   - Timing
   - Method
3. Achieve realistic production goals while ***minimizing N and P movement*** to surface waters
4. Can include certain flexibilities (Multi-year P application)

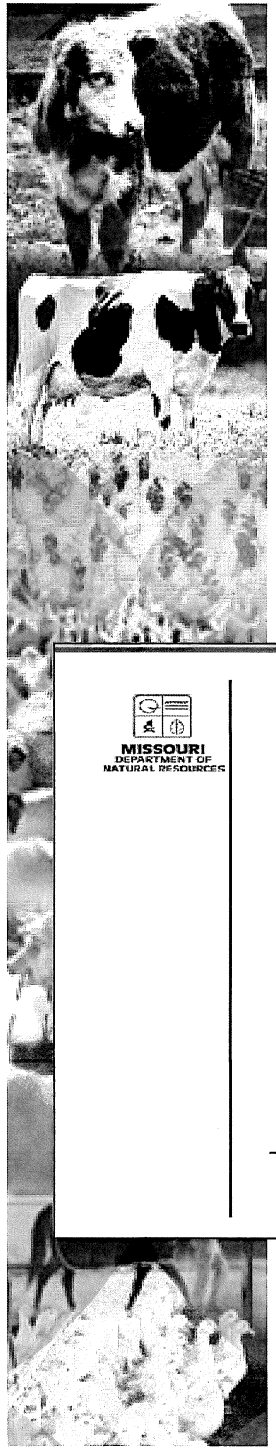
NMP Permit Terms - Protocols for Land Application

NMP Components	Linear	Narrative
Fields available for land application	✓	✓
Timing limitations for land application	✓	✓
Outcome of the assessment of the potential for N and P transport from each field	✓	✓
Planned crop or other use (e.g., fallow or pasture)	✓	✓
Alternative crops		✓
Realistic annual yield goal	✓	✓
Total N and P recommendation for each crop	✓	✓
Credits for plant available N in the field	✓	
Consideration of multi-year P application	✓	
Accounting for all other additions of PAN and P to the field (e.g., chemical fertilizer, etc.)	✓	
Method and timing of land application	✓	
Form and source of manure, litter, and process wastewater	✓	
Max. lbs of N and P from manure, litter, process wastewater (RATE)	✓	
Max. Amount of N and P from all sources (RATE)		✓
Methodology to account for the amount of N and P in the manure, litter, and process wastewater to be applied	✓	
Methodology to account for: • soil test results; • credits for plant available N in the field; • the amount of N and P in the manure, litter, and process wastewater; • consideration of multi-year P application; • accounting for all other additions of plant available N and P to the field; • form and source of manure, litter, and process wastewater; • timing and method of land application; • volatilization of nitrogen and mineralization of organic nitrogen		✓



Fields Available for Land Application

- Each field where land application will occur must be identified
- Each field should have a unique name or code
  - Field maps that are appropriately labeled to match fields listed in the NMP should also be included
- Spreadable land acres in each field



Fields Available for Land Application Field Size

- Technical standards can limit the allowable size of a field by setting limits on the acres that a soil sample can represent
- Example: Missouri's Technical Standard

MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Missouri Concentrated Animal Feeding Operat Nutrient Managemen Technical Standard

March 4, 2009

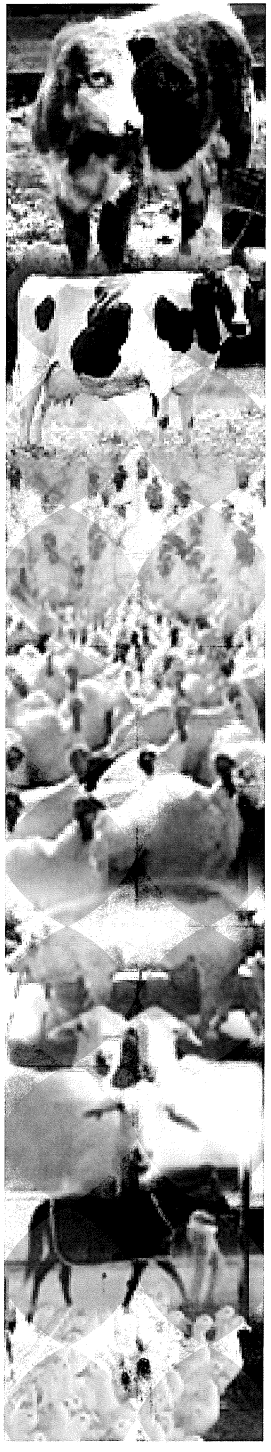
Division of Environmental Quality

Water Protection Program

plant analysis records, document how the crop is sampled and how plant analysis records are used to estimate nutrient removal for a crop;

e. Published nutrient removal estimates from other land grant universities in adjoining states are also acceptable.

f. Field-Level Fertilizer Applications – Fertilizer recommendations used to develop nutrient budgets shall be based on 20-acre field areas. When fertilizer recommendations are similar (within 10% or 10 pounds per acre, whichever is greater) for adjoining 20-acre field areas, they may be combined for purposes of fertilizer application and nutrient budgeting. Field areas of up to 80 acres may be combined using this guidance. Larger field areas may be combined if justification for this decision in documented in the nutrient management plan.



Timing Limitations for Land Application

- Identifies limitations or restrictions for land applying manure under certain conditions
  - Restrictions or limitations would be state specific
  - Identified in the state technical standards
- Example: Michigan's technical standard prohibits manure application under the following conditions
  1. CAFO waste shall not be applied on land that is flooded or saturated with water at the time of land application.
  2. CAFO waste shall not be applied during rainfall events.
  3. CAFO waste shall not be surface applied without incorporation to frozen or snow-covered ground, except in accordance with the Department 2005 Technical Standard for the Surface Application of CAFO Waste on Frozen or Snow-Covered Ground without Incorporation or Injection.
  4. CAFO waste application shall be delayed if rainfall exceeding one-half inch, or less if a lesser rainfall event is capable of producing an unauthorized discharge, is forecasted by the National Weather Service (NWS) during the planned time of application and within 24 hours after the time of the planned application.

Field Specific Assessment for the Potential of N and P Transport

- 2003 CAFO Rule Preamble
  - The current NRCS Nutrient Management technical standard describes three field-specific risk assessment methods to determine whether the land application rate is to be based on nitrogen or phosphorus, or whether land application is to be avoided. These three methods are:

    (1) Phosphorus Index;

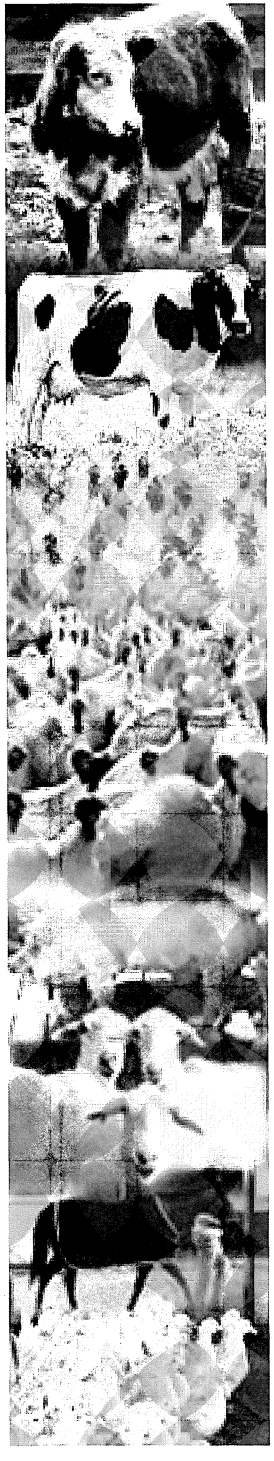
    (2) Soil Phosphorus Threshold Level; and

    (3) Soil Test Phosphorus Level

Soil Test Method

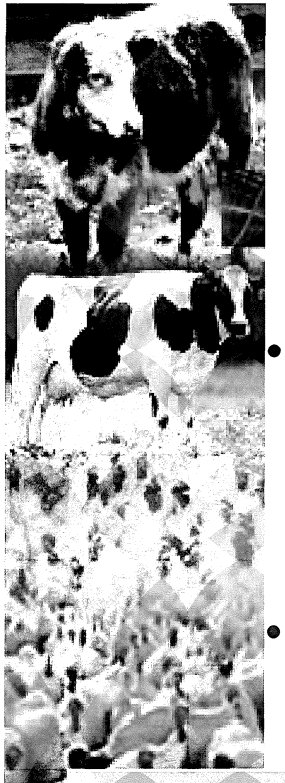
- Manure application rates are based around the soil test recommendations
- Example
  - Wisconsin's technical standard (NRCS 590 conservation code)

Soil Test P (ppm)	Allowable Application Rate
<50 ppm	Nutrient application rates allowed up to the N needs of the following crop or the N removal for the following legume crop
50 -100 ppm	P application shall not exceed the total crop P removal for crops to be grown over a maximum rotation length of 8 years
>100 ppm	Eliminate P applications, if possible, unless required by the highest P demanding crop in the rotation. If applications are necessary, applications shall be 25% less than the cumulative annual crop P removal over a maximum rotation length of 8 years



Phosphorus Index Rating

- Identifies sites where the risk of phosphorus movement may be relatively higher than that of other sites based on rating site characteristic:
  - Soil erosion
  - Irrigation erosion
  - Runoff class
  - Soil P test
  - P fertilizer application rate
  - P fertilizer application method
  - Organic P source application rate
  - Organic P source application method

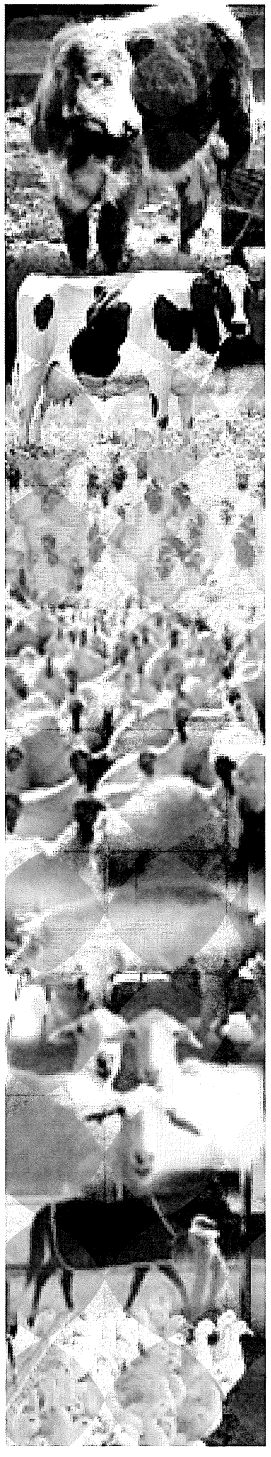


Phosphorus Index Rating

- Each site characteristic is weighted based on assumption that some characteristics may be more influential than others in moving phosphorus
- Each characteristic is rated according to a value category:
  - None, Low, Medium, High, or Very High

Site Characteristic	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)
Soil Erosion	N/A	< 5 tons/A	5-10 tons/A	10-15 tons/A	>15 tons/A

  - Each value category is based on quantitative/qualitative criteria
  - Each risk category is typically assigned an appropriate land application basis (N-based vs. P-base vs. No application)



N Risk Assessment?

- USDA's NRCS Nutrient Management Conservation Practice Standard, Code 590, also recommends utilizing a leaching index to assess the risk of nitrate leaching from a field to groundwater.

- ELGs have not been developed for discharges to groundwater, and therefore permit authorities are not required to write a permit term to address groundwater contamination;

- State permitting authorities may impose NPDES permit conditions for these discharges. 68 Fed. Reg. 7,216 (Feb. 12, 2003).

- Surface waters have a direct hydrological link to groundwater?
  - A nitrogen leaching index would be an appropriate tool for the permitting authority to include as part of the permit term.

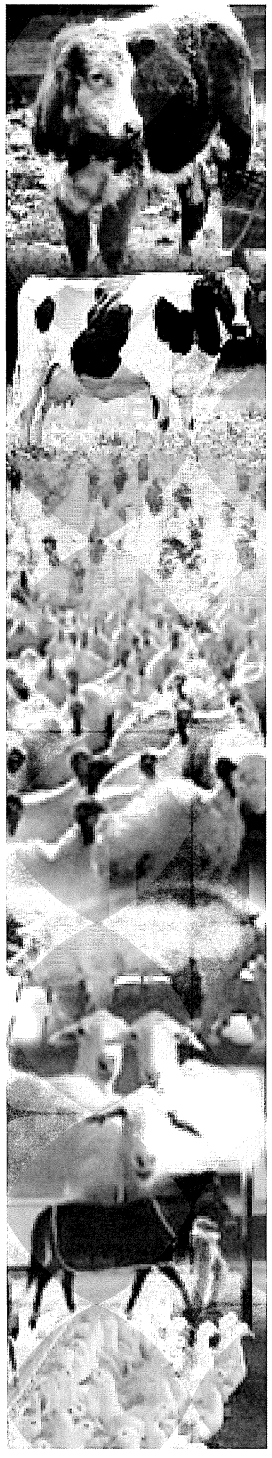
- Bottom Line: A nitrogen leaching index is not a requirement under this CAFO rule
  - However, many states have chosen to make the index a state specific requirement in their technical standards.

Planned Crops or Other Usage

- Without vegetative cover to actively utilize nutrients and prevent erosion, nutrients applied in manure could be washed directly into surface streams or leached into the ground water

- It will be important to distinguish legume crops from non-legume crops
  - Legume crops will impact other permit terms (i.e. N-credits)

Legumes Crops	Non-Legume Crops
Soybeans	Corn
Alfalfa	Wheat
Lentils	Oats
Sweetclover	Rye
Redclover	Bluegrass
Peas	Sorghum



Realistic Annual Crop Yield Goals

- Crop yields are determined by a number of factors including:
  - Soil fertility
  - Soil type
  - Soil management
  - Climate
  - Pest control
  - Crop variety

- The amount of nutrients required by a crop varies directly with the yield

- States should establish in their technical standards criteria for deriving realistic yield goals
  - Wisconsin Technical standard example
    - *"Yield goals should not be higher than 15% above the previous 3-5 year average" - WI NRCS 590*

Total N and P Recommendations

- Crop nutrient recommendations can be approached in different manners
  - Crop removal rates
  - Crop uptake rates
  - Crop fertilizer recommendations
- Removal rates
  - The amount of nutrients that the crop will remove in its biomass
    - A function of the crop and the yield
- Fertilizer recommendations
  - A soil sample is analyzed for various elements or nutrients which can be readily extracted and determined to be plant available

Fertilizer Recommendations vs. Removal Rates

Example for phosphorus:

Table 12.
NUTRIENTS REMOVED IN HARVESTED PORTIONS OF AGRONOMIC CROPS.

Crop	Unit of yield	Nutrient removed per unit of yield	
		P_2O_5	K_2O
		—— lb /unit——	
Corn			
Feed grain	bushel	0.37	0.27
Silage	ton	3.30	8.00
Soybeans	bushel	0.80	1.40
Wheat			
Grain	bushel	0.63	0.37
Straw	bushel	0.09	0.91
Alfalfa	ton	13.00	50.00

Table 14.
PHOSPHATE (P_2O_5) RECOMMENDATIONS FOR CORN SILAGE.

Soil test	Yield potential — tons per acre				
	20	22	24	26	28
ppm (lb/acre)	——lb P_2O_5 per acre——				
5 (10)[1]	115	125	130	135	140
10 (20)	90	100	105	110	115
15-30 (30-60)[2]	65	75	80	85	90
35 (70)	35	40	40	45	45
40 (80)	0	0	0	0	0

[1] Values in parentheses are lb/acre.
[2] Maintenance recommendations are given for this soil test range.

REMOVAL RATE
Corn Silage at 24 tons
24 tons * 3.3 lbs P_2O_5/ton = 79 lbs P_2O_5

Corn Silage at 24 tons
130, 105, 80, 40 or 0 lbs P_2O_5

Nitrogen Recommendations

- Legumes will supply and meet their own N needs through nitrogen fixation
  - Soil test recommendations are typically 0 lbs N
- Some states allow for manure to be applied to legumes
  - Legumes will reduce the amount of N that is fixed
  - Legume will still utilize other nutrients in the manure
  - Some evidence of increase in yield
- Removal rates can be used if allowed by the state's technical standards
  - Example Indiana technical standard (IN 590):

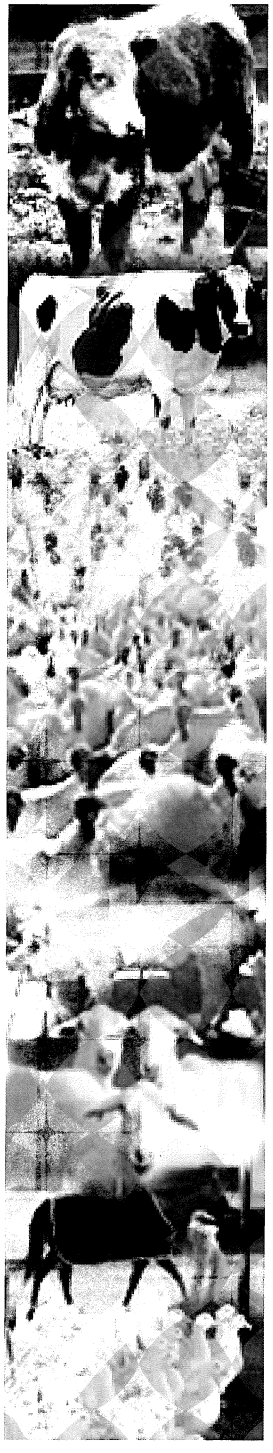
    Application rates for legume crops are as follows:

    Soybean – Up to 150 lbs N/Ac/yr

    Legume Hay – Up to 75 lbs N/Ac/harvest of hay, not-to-exceed 300 lbs N/Ac/yr

Phosphorus Recommendations

- P recommendations can follow either the P removal rate or the phosphorus fertilizer recommendation
  - Typically use whatever is greater
- Fields with a low soil phosphorus test (STP)
  - Essential to build up STP and a removal rate would only maintain a low STP
  - Following STP will increase the STP and decreases the recommendation over time



Terms Applicable Only to Linear Approach

- Credits for Plant Available Nitrogen (PAN) in the Field
- Consideration of multi-year P Application
- Accounting for All Other Additions of PAN
- Timing and Method of Land Application
- Form and Source of Manure Land Applied
- Maximum pounds of N and P from Manure
- Methodology to Account for the Amount of N and P in the Manure to be Applied

Credits for Plant Available Nitrogen (PAN) in the Field

- Common credits of PAN:
  - Organic N from manure applications that mineralize over multiple years
  - Credits supplied from leguminous crops

- State technical standards should
  - Provide mineralization coefficients that are based on the type of manure being applied and the time of year that application is occurring
  - Legume credits
  - *Organic matter? – will depend on if state requires testing for OM*

Credits for PAN in the Field

Indiana's Technical standard:

Source	Nitrogen Credit (lbs/ac)
From Soil Organic Matter (O.M.):	
0-8% O.M. Mineral Soils	0
> 20% O.M. Organic Soils 2)	40
From Previous Crops:	
Corn & Most Crops	0
Soybean prior to corn only	30
Grass Sod & Pastures	40
Established Forages Legumes 3) 40 + 20 X (plants/sq. ft.) [Max 140 lbs/ac]	40-140 5)
Annual Legume Cover Crop 4)	30 5)

Footnotes:

1. Tri-State Fertilizer Recommendations Extension Bulletin E-2567, July 1995.

2. For organic soils with greater than 20 percent organic matter, adjust rates using a pre-side dress N soil test or reduce N rates by 40 lb/acre.

3. Established more than one year.

4. N credit is variable. When a heavy growth follows small grain harvest the N credit can be considerably higher.

5. Actual N availability will depend on how the forage is managed. If the forage is incorporated (even shallow) the N availability is generally (weather dependent) much higher. If forage residue is left on top (No till) breakdown of the organic N and movement into the soil is very moisture dependent. A dry year will capture less of the potential nitrogen.

Consideration of a Multi-Year P Application

- A single application of manure at a rate equal to the recommended P application rate for multiple years in the crop rotation

- EPA allows multi-year P application only when permissible under the state's technical standards

- Restrictions by state standards should include:
  1. A single application should not exceed the recommended N application rate during the year of application

  2. Should not occur on sites considered vulnerable to off-site P transport unless appropriate conservation practices, BMPs or other management activities are used to reduce the vulnerability

  3. No additional P should be applied to these fields until the amount applied in the single year has been removed through plant up take and harvest

Accounting for All Other Additions of Plant available N & P

- The total amount of N from source other than manure
  - Fertilizers
  - Biosolids
  - Does not include the N credits previously discussed
- The term is “accounting”
  - It is not the actual numeric value of what is applied

Timing and Method of Land Application

- Timing
  - As it affects nutrient availability when calculating the application rate
    - Factors (soil/air temp and moisture) that affect the mineralization of organic N
  - Capturing application timing as a season even if the NMP is more specific would be appropriate

Table 9.9. Fraction of organic N mineralized from various manure types and application scenarios in the year of application. (Virginia Department of Conservation and Recreation, 2005.)

Manure type	Spring or early fall applied[a]	Winter topdress or spring residual[b]	Perennial grass
	----- N mineralization factor -----		
Dairy or beef	0.35	0.20/0.15	0.35
Swine	0.50	0.25/0.25	0.50
Poultry	0.60	0.30/0.30	0.60

[a] Factors for manure applied in spring for summer annual crops or in early fall for small grain crops.
[b] Factors for manure applied in early winter/available in spring.

Timing and Method of Land Application

- Method
  - As it affects nutrient availability in the application rate calculation
  - The method of land application affects the volatilization of N
    - How much and how quickly does manure contact the soil
  - Equipment used (big gun, injections, broadcast, etc) to apply the manure

- A timing aspect can also be tied to the method of land application
  - Days to incorporate

Form and Source of Manure Land Applied

- Form - The form of the manure (solid, liquid, compost, etc) being land applied
- Source - The storage structure containing the manure to be land applied

Maximum Amount of N and P from Manure

- Includes the maximum application rate of N and P from manure in pounds per acre, per year, in chemical forms determined to be acceptable to the Director
- Does not include residual manure credits
- The maximum rate must be calculated for each crop on each field identified in the NMP
- Permitted CAFOs must calculate the maximum amount of manure to be land applied at least once each year.
- The tons or gallons of manure are not the enforceable permit term

Linear Rate Approach Methodology

- To Account for the amount of N and P in the manure to be land applied

- How was the quantity of manure to be applied to a given field and crop calculated?
  - Based on nutrients in the manure
  - Large CAFOs must use the results of the most recent representative manure tests for N and P taken within at least 12 months of the date of land application

Linear Rate Approach Summary

1. The NMP as submitted with the NOI is the NMP that is to be implemented over the 5 years of permit coverage

2. The rates, methods, timing, and source of manure nutrients are to be applied as predicted by the NMP

3. The linear approach is for operators who do not anticipate that the NMP will change once it is developed

Terms Applicable Only to the Narrative Rate Approach

- Use of Alternative Crops
- Methodology
- Maximum Amount of Nitrogen and Phosphorus from All Sources

Alternative Crops

- Alternative crops may be included as long as the NMP includes, for each alternative crop
  - The field it will be used on
  - Realistic Yield Goals
  - Nitrogen and Phosphorus Recommendations

- Recognize that when an alternative crop is used, application rates may need to be adjusted for all years following the implementation of the alternative crop
  - If a leguminous crop is added or removed from a rotation, this will either add or remove N credits
  - Potential to impact the risk rating for a field.

Methodology

- The methodology for calculating the amount of manure to be applied

- Methodology must account for certain factors:
  - Results of soil tests;
  - Credits for all N in the field that will be plant available;
  - The amount of N and P in the manure to be applied;
  - Consideration of multi-year P application;
  - All other additions of PAN and phosphorus to the field;
  - The form and source of manure to be applied;
  - The timing and method of land application; and
  - Volatilization and mineralization of N

Methodology

- Many of the factors of the narrative rate methodology are permit terms under the linear rate approach
  - Credits for PAN in the field
  - Accounting for all other additions of PAN and P to the field
  - Consideration of multi-year P application
  - Form and source of manure to be applied
  - Timing and method of land application
- The following factors are required by methodology of the narrative rate approach but are not permit terms under the linear rate approach
  - Mineralization of organic nitrogen and volatilization of N
  - Results of the soil test

Methodology

- The CAFO operator will be bound by
  - The methodology and the way in which the factors are accounted for in calculating the actual amount of manure to be applied to the field
  - The criteria established in the technical standards
    - Many standards provide choices, such as multiple possible risk assessments
    - Whatever is used in the NMP submitted with the NOI must be used throughout

The Maximum Amounts of N & P From All Sources

- The maximum amount of N and P is the limit set for each crop identified in the NMP in chemical forms determined to be acceptable to the Director, in pounds per acre, for each field.
  - A 5 year NMP may have a crop planted on a field each year but it may the same crop or it may only be 2 different crops
  - Remember: Linear Rate Maximum limit is set for each year

How is this value determined ?

PART II